Product Title: Reliability of HTS Microwave Devices #90

Product Description: Investigate aging and environmental effects on High Temperature Superconducting (HTS) microwave circuits through the analysis of local oscillators, with the objective of evaluating the maturity level and readiness of HTS circuits for satellite communication applications.

Performance Period: FY98 - FY00

Center: Glenn Research Center

Point of Contact: Dr. Félix A. Miranda Code: 5620
216-433-6589
216-433-8705 (FAX)
F.A.Miranda@lerc.nasa.gov

Thrust Area: Microelectronics Reliability

Status: X New __Ongoing -

Benefit: The surge of wireless communication of voice, video, and data is creating a tremendous demand for channel bandwidth and its driving transceivers systems to frequencies beyond the K- and Ka-bands. Therefore, miniaturized, low cost and highly efficient HTS-based microwave circuits (e.g., local oscillators), are a desired technology for insertion into the next generation of satellite communication systems. The long erm performance of these components is directly related to the quality (i.e., maturity and stability) of the available HTS thin films, the fabrication processes, and the actual environment in which the device must perform. Thus, knowledge of the performance of a statistically meaningful number of local oscillators under a continuous duty cycle designed to resemble as much as possible actual working conditions will provide critical information regarding the maturity level and readiness for insertion of HTS circuits for space communication applications.

Beneficiaries: X Push __Pull - Commercial Communication Programs (NASA GRC) and NASA Space Science Enterprise (Deep Space Programs, JPL)

Product Objectives:

- To survey the current state-of-the-art manufacturing processes within the HTS industry worldwide.
- To study the reliability and failure mechanisms of HTS-based circuits (i.e., operating temperature, power handling capability, phase noise, microphonics, etc.).
- To investigate aging and environmental effects on HTS microwave circuits through the analysis of the performance of local oscillators.
- To determine the maturity level and readiness for insertion of HTS circuits into satellite communications systems.

Program Alignment: **Ojective 1: Accelerate the Readiness of New Technologies Through Development of Validation Assessments and Test Methods/Tools:**

- Determine the reliability and failure mechanisms of HTS-based circuits in terms of type of film, film fabrication techniques, film manufacturer, circuit processing technologies and working environment conditions.

- This project will provide a validation assessment of thin film quality evaluation techniques currently in use.

Objective 2: Provide Project's Infusion Paths for Emerging Technologies:

- The results and recommendations arising from this study will allow technologists and project managers to formulate realistic assessments and plans regarding the use of HTS technology for satellite communications.

Objective 3: Provide Projects with Technology Selection, Application, and Validation Guidelines for Hardware and Processes:

- A final report summarizing the information obtained in this study will be published. This information will enable technologist and program managers to determine the yield, availability, and reliability of HTS-based microwave components for satellite communication systems.

Objective 4: Disseminate Quality Assurance, Reliability, Validation, Tools, and Availability Information to the NASA Community:

- This will be achieved through the publication of a Reliability of HTS Microwave Devices Report and technical papers in the open literature.
- Present results at NASA sponsored conferences and international symposia to ensure fast and ample dissemination of this information.

Technical Approach:

This task will be accomplished applying the following methodology:

- Perform assessment of HTS films availability through an Industry Survey outlining products, capabilities, and other film related information.
- Procurement and in-house fabrication and characterization of test structures and devices.
- Study effect of working environment, processing, and aging of HTS circuits by monitoring their performance as a function of time.
- Analysis and reporting of findings with recommendations on future development needs necessary to accelerate the insertion of this technology into NASA's and commercial microwave communication systems.

Deliverables and Milestones:

- Industry Survey Report (ISR) summarizing products, capabilities and other HTS-film related information (Jan. FY98).
- Study of processing and environmental effects on HTS films deposited by different methods on different substrates and patterned using different techniques. These effects will be analyzed by measuring dc (e.g., T_c and J_c) and rf (e.g., Q, R_s, λ_o) film properties (June, FY99).
- Study of performance of HTS-based LO under extended period duty cycles (June, FY00).
- Report on operation condition effects on HTS-based microwave device reliability and risk factors (Sept., FY00).

Partners/Collaborators:

This study will be performed at Glenn Research Center. Circuit fabrication support as required will be subcontracted to JPL and/or industry (as identified in the ISR).